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INDIAN LAKE SOMERSET COUNTY, PENNSYLVANIA

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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

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REPORT
ON
INDIAN LAKE
SOMERSET COUNTY
PENNSYLVANIA

EPA REGION III

WORKING PAPER No. 420

WITH THE COOPERATION OF THE

PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES

AND THE

PENNSYLVANIA NATIONAL GUARD

JUNE, 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Pennsylvania Department of Environmental Resources for professional involvement and to the Pennsylvania National Guard for conducting the tributary sampling phase of the Survey.

Walter A. Lyon, Director of the Bureau of Water Quality Management, Richard M. Boardman, Chief of the Division of Water Quality, and James T. Ulanoski, Aquatic Biologist of the Division of Water Quality, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

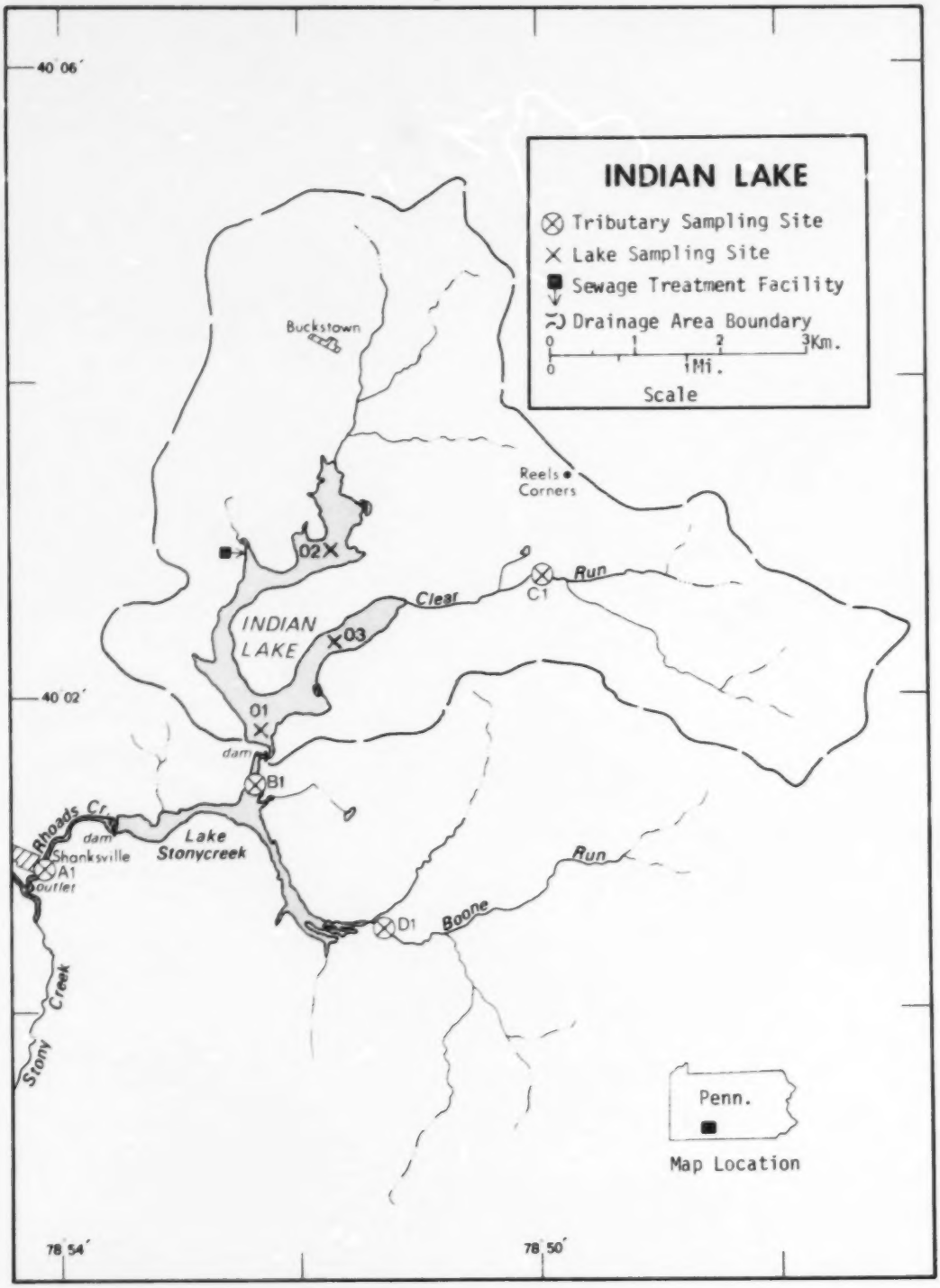
Major General Harry J. Mier, Jr., the Adjutant General of Pennsylvania, and Project Officer Major Ronald E. Wickard, who directed the volunteer efforts of the Pennsylvania National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF PENNSYLVANIA

LAKE NAME	COUNTY
Allegheny Reservoir	McKean, Warren, PA; Cattarugus, NY
Beaver Run Reservoir	Westmoreland
Beltzville	Carbon
Blanchard Reservoir	Centre
Canadohta	Crawford
Conneaut	Crawford
Conewago (Pinchot)	York
Greenlane	Montgomery
Harveys	Luzerne
Indian	Somerset
Naomi	Monroe
Ontelaunee	Berks
Pocono	Monroe
Pymatuning Reservoir	Crawford, PA; Ashtabula, OH
Shenango River Reservoir	Mercer
Stillwater	Monroe
Wallenpaupack	Pike, Wayne


INDIAN LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Drainage Area Boundary
0 1 2 3Km.
0 1Mi.
Scale
40 06'
40 02'
78 54'
78 50'
Buckstown
Reels Corners
02
Clear Run
C1
INDIAN LAKE
03
01
dam
B1
Rhoads Cr.
dam
Shanksville
A1
outlet
Lake Stonycreek
Run
Boone
D1
Stony Creek
Penn.
Map Location

INDIAN LAKE

STORET NO. 4223

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Indian Lake is mesotrophic. It ranked sixth in overall trophic quality when the 17 Pennsylvania lakes sampled in 1973 were compared using an index of six parameters**. None of the lakes had less median total phosphorus, one had less and three had the same median dissolved phosphorus, 11 had less median inorganic nitrogen, three had less mean chlorophyll a, and four lakes had greater mean Secchi disc transparency. Marked depression of dissolved oxygen with depth occurred at the deeper stations 1 and 3 in July and October, 1973.

Survey limnologists did not observe any nuisance conditions during their visits to the lake.

B. Rate-Limiting Nutrient:

The algal assay results indicate Indian Lake was phosphorus limited at the time the assay sample was collected (04/23/73). The lake data indicate phosphorus limitation at all sampling times.

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* Table of metric conversions--Appendix A.
** See Appendix B.

C. Nutrient Controllability:

1. Point sources--The phosphorus contribution of the only known wastewater treatment plant (Indian Lake Lodge) amounted to 7.6% of the total reaching the lake. However, this plant no longer discharges to the lake; and, therefore, the present total phosphorus loading to the lake is less than the load measured during the Survey sampling year.

The present phosphorus loading rate to Indian Lake is well below the rate proposed by Vollenweider (Vollenweider and Dillon, 1974) as an oligotrophic rate (see page 13). Any addition to the existing phosphorus loading of this lake should be carefully evaluated with regard to the effect on the existing high quality.

2. Non-point sources--The phosphorus load from non-point sources was 74.2% of the total reaching the lake during the sampling year. Clear Run contributed 12.1%, and the ungaged tributaries and immediate drainage were estimated to have contributed 45.4% of the non-point source phosphorus load. The phosphorus export of Clear Run was a very low 5 $kg/km^2/yr$ (see page 13).

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 3.04 kilometers^2.
2. Mean depth: 4.3 meters.
3. Maximum depth: 18.3 meters.
4. Volume: 13.072 x 10^6 m^3.
5. Mean hydraulic retention time: 303 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Clear Run	8.4	0.1
Minor tributaries & immediate drainage -	24.7	0.4
Totals	33.1	0.5

2. Outlet -

Unnamed Stream (B-1)	36.1**	0.5**

C. Precipitation***:

1. Year of sampling: 102.8 centimeters.
2. Mean annual: 114.4 centimeters.

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† Ulanoski, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976"; also see footnote, page 9.
** Includes area of lake; outflow adjusted to equal the sum of the inflows.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Indian Lake was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from a number of depths at each station (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the three stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 16.8 meters at station 1, 5.5 meters at station 2, and 8.8 meters at station 3.

The lake sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR INDIAN LAKE
STORET CODE 4223

PARAMETER	1ST SAMPLING (4/23/73) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/25/73) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/ 4/73) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	6.7 - 14.5	10.7	11.3	8.0 - 23.6	20.1	22.9	7.9 - 17.9	14.8	16.9
DISS OXY (MG/L)	9.8 - 10.9	10.5	10.5	0.8 - 9.8	6.8	7.4	0.2 - 8.8	4.8	7.0
CNDCTVY (MCROMO)	110. - 120.	113.	110.	72. - 110.	98.	104.	79. - 100.	91.	91.
PH (STAND UNITS)	6.7 - 7.1	6.9	6.8	5.7 - 7.1	6.2	6.0	6.0 - 6.6	6.3	6.3
TOT ALK (MG/L)	10. - 15.	11.	11.	10. - 10.	10.	10.	10. - 21.	13.	10.
TOT P (MG/L)	0.004 - 0.008	0.005	0.005	0.008 - 0.013	0.010	0.010	0.006 - 0.069	0.014	0.008
ORTHO P (MG/L)	0.003 - 0.006	0.004	0.004	0.003 - 0.007	0.005	0.005	0.003 - 0.007	0.006	0.006
NO2+NO3 (MG/L)	0.490 - 0.540	0.507	0.500	0.240 - 0.450	0.316	0.330	0.040 - 0.270	0.136	0.150
AMMONIA (MG/L)	0.060 - 0.100	0.080	0.090	0.040 - 0.320	0.099	0.070	0.070 - 0.860	0.295	0.170
KJEL N (MG/L)	0.200 - 0.500	0.225	0.200	0.200 - 0.800	0.500	0.550	0.400 - 1.300	0.745	0.700
INORG N (MG/L)	0.580 - 0.620	0.595	0.590	0.280 - 0.360	0.415	0.415	0.220 - 0.400	0.431	0.330
TOTAL N (MG/L)	0.690 - 0.990	0.732	0.705	0.530 - 1.120	0.816	0.795	0.560 - 1.340	0.882	0.950
CHLRPYL A (UG/L)	0.6 - 1.1	0.8	0.8	4.6 - 9.9	7.4	7.8	6.9 - 8.2	7.4	7.0
SECCHI (METERS)	1.8 - 3.7	2.6	2.3	2.1 - 3.7	2.9	3.0	2.0 - 2.1	2.1	2.1

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal units per ml
04/23/73	1. Chrysophyta cells	100
	2. Dinobryon	60
	3. Gymnodinium	33
	4. Synedra	20
	5. Cyclotella	13
	Other genera	7
	Total	233
07/25/73	1. Cyclotella	949
	2. Chlorophyta cells	161
	3. Flagellates	80
	4. Peridinium	48
	5. Synedra	16
	Other genera	16
	Total	1,270
10/04/73	1. Cyclotella	1,559
	2. Flagellates	219
	3. Ankistrodesmus (?)	146
	4. Oocystis	87
	5. Xanthidium	58
	Other genera	131
	Total	2,200

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
04/23/73	01	0.8
	02	1.1
	03	0.6
07/25/73	01	7.8
	02	9.9
	03	4.6
10/04/73	01	6.9
	02	7.0
	03	8.2

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.008	0.614	0.1
0.050 P	0.058	0.614	9.8
0.050 P + 1.0 N	0.058	1.614	17.5
1.0 N	0.008	1.614	0.1

2. Discussion -

The control yield of the assay alga, *Selenastrum capricornutum*, indicates that the potential primary productivity of Indian Lake was low at the time the sample was collected (04/23/73). The results also indicate that Indian Lake was phosphorus limited at that time (note the significant increase in yield with the addition of orthophosphorus and the lack of an increase in yield with the addition of nitrogen).

The lake data also indicate phosphorus limitation. The mean N/P ratios were 72/1 or greater at all sampling times, and phosphorus limitation would be expected.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Pennsylvania National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of February and March when two samples were collected. Sampling was begun in May, 1973, and was completed in April, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Pennsylvania District Office of the U.S. Geological Survey for the tributary sites nearest the lake*.

In this report, nutrient loads for sampled tributaries were calculated using mean annual concentrations and mean annual flows. Nutrient loads shown are those measured minus point-source loads, if any. Although Boone Run and Rhoads Creek do not affect Indian Lake, the data are included in Appendix E for the record.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the mean annual

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* To effectively treat Indian Lake as a separate hydraulic system, the drainage area for station B-1 was planimetered using U.S.G.S. maps. The gaged discharges, in m^3/km^2, at stations A-1, C-1, and D-1 were averaged and applied to the B-1 drainage area to obtain a flow. Thus the flow at B-1 now represents the outlet flow of Indian Lake. The drainage area for "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) was obtained by subtracting the surface area of the lake and the sub-drainage area of C-1 from the total planimetered drainage of Indian Lake (at station B-1), and the averaged discharge was then applied to the "ZZ" drainage area to obtain a flow (see page 3).

concentrations in Clear Run at station C-1 and the mean annual ZZ flow.

The operator of the Indian Lake Lodge wastewater treatment plant provided monthly effluent samples and corresponding flow data.

A. Waste Sources:

1. Known municipal -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Indian Lake Lodge*	47**	pond	17.9	Indian Lake

2. Known industrial - None

* Kimmel, 1975 (as of 10/31/74, this plant was no longer in operation).
** Estimate based on flow at 0.3785 m^3/capita/day.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Clear Run	40	12.1
b. Minor tributaries & immediate drainage (non-point load) -	150	45.4
c. Known municipal STP's -		
Indian Lake Lodge	25	7.6
d. Septic tanks* -	60	18.2
e. Known industrial - None	-	-
f. Direct precipitation** -	55	16.7
Total	330	100.0

2. Outputs -

Lake outlet - Unnamed Stream (B-1) 175

3. Net annual P accumulation - 155 kg.

* Estimate based on 220 lakeside dwellings; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/ yr	% of total
a. Tributaries (non-point load) -		
Clear Run	4,605	16.0
b. Minor tributaries & immediate drainage (non-point load) -	18,415	64.0
c. Known municipal STP's -		
Indian Lake Lodge	140	0.5
d. Septic tanks* -	2,345	8.1
e. Known industrial - None	-	-
f. Direct precipitation** -	3,280	11.4
Total	28,785	100.0

2. Outputs -

Lake outlet - Unnamed Stream (B-1)	18,920

3. Net annual N accumulation - 9,865 kg.

* Estimate based on 220 lakeside dwellings; see Working Paper No. 175.
** See Working Paper No. 175.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Clear Run	5	548

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" rate is the rate at which the receiving water would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.11	0.05	9.5	3.2

Vollenweider loading rates for phosphorus (g/m^2/yr) based on mean depth and mean hydraulic retention time of Indian Lake:

"Dangerous" (eutrophic rate)	0.44
"Permissible" (oligotrophic rate)	0.22

V. LITERATURE REVIEWED

Kimmel, Clair (Operator), 1975. Personal communication (point sources impacting Indian Lake). Central City STP, Central City.

Ulanoski, James, 1974. Personal communication (lake morphometry). PA Dept. of Env. Resources, Harrisburg.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.5214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	4224	LAKE NAOMI	445
2	4220	BELTZVILLE DAM	423
3	4222	HARVEY'S LAKE	413
4	4228	STILLWATER LAKE	401
5	4227	POCONO LAKE	389
6	4223	INDIAN LAKE	388
7	3641	ALLEGHENY RESERVOIR	385
8	4229	LAKE WALLENPAUPACK	371
9	4221	CANADOHTA LAKE	369
10	4219	BEAVER RUN RESERVOIR	360
11	4204	CONNEAUT LAKE	307
12	4226	PINCHOT LAKE	256
13	4213	PYMATUNING RESERVOIR	206
14	4216	SHENANGO RIVER RESERVOIR	157
15	4225	ONTELAUNEE DAM	101
16	4201	BLANCHARD RESERVOIR	85
17	4207	GREENLANE DAM	53

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS P	INDEX NO
3641	ALLEGHENY RESERVOIR	56 (9)	38 (6)	63 (10)	100 (16)	69 (11)	59 (8)	385
4201	BLANCHARD RESERVOIR	13 (2)	13 (2)	25 (4)	31 (5)	3 (0)	0 (0)	85
4204	CONNEAUT LAKE	44 (7)	63 (10)	69 (11)	56 (9)	34 (5)	41 (6)	307
4207	GREENLANE DAM	6 (1)	6 (1)	19 (3)	13 (2)	3 (0)	6 (1)	53
4213	PYMATUNING RESERVOIR	0 (0)	72 (11)	6 (1)	0 (0)	100 (16)	28 (4)	206
4216	SHENANGO RIVER RESERVOIR	19 (3)	44 (7)	13 (2)	6 (1)	47 (7)	28 (4)	157
4219	BEAVER RUN RESERVOIR	94 (15)	19 (3)	88 (14)	81 (13)	19 (2)	59 (8)	360
4220	BELTZVILLE DAM	88 (14)	25 (4)	94 (15)	94 (15)	34 (5)	88 (13)	423
4221	CANADOHTA LAKE	50 (8)	97 (15)	56 (9)	19 (3)	59 (9)	88 (13)	369
4222	HARVEY'S LAKE	63 (10)	81 (13)	100 (16)	63 (10)	47 (7)	59 (8)	413
4223	INDIAN LAKE	100 (16)	31 (5)	75 (12)	75 (12)	19 (2)	88 (13)	388
4224	LAKE NAOMI	81 (13)	88 (14)	44 (7)	69 (11)	88 (14)	75 (12)	445
4225	ONTELAUNEE DAM	25 (4)	0 (0)	0 (0)	44 (7)	19 (2)	13 (2)	101
4226	PINCHOT LAKE	31 (5)	56 (9)	31 (5)	38 (6)	81 (13)	19 (3)	256
4227	POCONO LAKE	38 (6)	97 (15)	50 (8)	88 (14)	75 (12)	41 (6)	389
4228	STILLWATER LAKE	72 (11)	72 (11)	38 (6)	25 (4)	94 (15)	100 (16)	401
4229	LAKE WALLENPAUPACK	72 (11)	50 (8)	81 (13)	50 (8)	59 (9)	59 (8)	371

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS P
3641	ALLEGHENY RESERVOIR	0.016	0.380	414.250	3.700	13.800	0.006
4201	BLANCHARD RESERVOIR	0.064	1.300	453.143	15.187	14.900	0.046
4204	CONNEAUT LAKE	0.023	0.185	402.000	7.567	14.600	0.007
4207	GREENLANE DAM	0.066	1.475	460.222	24.011	14.900	0.020
4213	PYMATUNING RESERVOIR	0.070	0.180	467.750	56.333	7.700	0.008
4216	SHENANGO RIVER RESERVOIR	0.058	0.340	463.555	26.800	14.500	0.008
4219	BEAVER RUN RESERVOIR	0.009	0.835	384.833	5.183	14.800	0.006
4220	BELTZVILLE DAM	0.010	0.815	362.444	4.856	14.600	0.005
4221	CANADOHTA LAKE	0.020	0.130	436.000	19.167	14.100	0.005
4222	HARVEY'S LAKE	0.015	0.160	338.000	5.967	14.500	0.006
4223	INDIAN LAKE	0.008	0.520	400.222	5.211	14.800	0.005
4224	LAKE NAOMI	0.014	0.135	443.333	5.533	8.000	0.005
4225	ONTELAUNEE DAM	0.040	2.150	470.667	11.783	14.800	0.011
4226	PINCHOT LAKE	0.027	0.245	453.000	13.950	11.500	0.008
4227	POCONO LAKE	0.024	0.130	438.800	4.980	13.200	0.007
4228	STILLWATER LAKE	0.015	0.180	449.000	18.233	7.900	0.004
4229	LAKE WALLENPAUPACK	0.015	0.250	394.583	9.617	14.100	0.006

TRIBUTARY FLOW INFORMATION FOR PENNSYLVANIA 2/24/75

LAKE CODE 4223 INDIAN LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 67.6

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
4223A1	67.6	1.02	1.53	2.93	2.63	1.70	1.21	0.46	0.27	0.21	0.28	0.83	1.21	1.19
4223B1	1.6	0.02	0.02	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.02
4223C1	12.6	0.15	0.22	0.40	0.37	0.24	0.19	0.07	0.05	0.04	0.05	0.13	0.19	0.17
4223D1	25.1	0.26	0.34	0.57	0.54	0.40	0.31	0.12	0.10	0.08	0.10	0.22	0.31	0.28
4223Z2	28.2	0.51	0.74	1.39	1.27	0.82	0.52	0.19	0.13	0.10	0.14	0.42	0.62	0.58

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 67.6
SUM OF SUB-DRAINAGE AREAS = 67.5
TOTAL FLOW IN = 12.80
TOTAL FLOW OUT = 14.27

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
4223A1	5	73	1.78	19	1.16				
	6	73	0.71	17	0.68				
	7	73	0.14	15	0.14				
	8	73	0.15	12	0.08				
	9	73	0.14	9	0.06				
	10	73	1.27	14	0.17				
	11	73	1.40	11	0.79				
	12	73	2.27	9	2.04				
	1	74	2.97	13	2.63				
	2	74	0.85	10	0.62				
	3	74	1.36	10	3.40				
	4	74	1.33	14	1.93				
4223B1	5	73	0.02	19	0.02				
	6	73	0.01	17	0.01				
	7	73	0.01	15	0.01				
	8	73	0.01	12	0.00				
	9	73	0.01	9	0.00				
	10	73	0.02	14	0.01				
	11	73	0.02	11	0.02				
	12	73	0.03	9	0.03				
	1	74	0.03	13	0.03				
	2	74	0.02	10	0.01				
	3	74	0.02	10	0.03				
	4	74	0.02	14	0.02				

LAKE CODE 4223 INDIAN LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
4223C1	5	73	0.25	19	0.17				
	6	73	0.11	17	0.11				
	7	73	0.03	15	0.03				
	8	73	0.03	12	0.02				
	9	73	0.03	9	0.01				
	10	73	0.19	14	0.03				
	11	73	0.22	11	0.12				
	12	73	0.31	9	0.28				
	1	74	0.40	13	0.37				
	2	74	0.13	10	0.10				
	3	74	0.20	10	0.45				
	4	74	0.19	14	0.27				
4223D1	5	73	0.40	19	0.28				
	6	73	0.19	17	0.19				
	7	73	0.06	15	0.06				
	8	73	0.05	12	0.03				
	9	73	0.05	9	0.03				
	10	73	0.31	14	0.07				
	11	73	0.34	11	0.22				
	12	73	0.48	9	0.42				
	1	74	0.59	13	0.54				
	2	74	0.23	10	0.18				
	3	74	0.34	10	0.65				
	4	74	0.31	14	0.42				
4223Z2	5	73	0.68	19	0.57				
	6	73	0.34	17	0.34				
	7	73	0.07	15	0.07				
	8	73	0.08	12	0.04				
	9	73	0.07	9	0.03				
	10	73	0.62	14	0.08				
	11	73	0.74	11	0.40				
	12	73	1.10	9	0.99				
	1	74	1.44	13	1.27				
	2	74	0.42	10	0.31				
	3	74	0.65	10	1.54				
	4	74	0.65	14	0.93				

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/01/27

422301
40 01 40.0 078 52 23.0
INDIAN LAKE
42111 PENNSYLVANIA

11EPALES
3

2111202
0054 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/23	11 35	0000	11.8		96	115	7.10	12	0.090	0.200K	0.510	0.006
	11 35	0004	11.8	10.5		110	7.10	11	0.100	0.200K	0.520	0.005
	11 35	0015	10.9	10.9		110	7.10	12	0.080	0.200K	0.510	0.004
	11 35	0029	7.4	10.6		110	7.10	13	0.090	0.200K	0.500	0.005
	11 35	0040	6.7	10.5		110	7.10	14	0.090	0.200K	0.490	0.006
73/07/25	11 40	0000	22.9		144	100	5.90	10K	0.090	0.300	0.340	0.007
	11 40	0005	22.9	7.4		104	6.00	10K	0.110	0.200K	0.330	0.005
	11 40	0015	22.7	7.4		104	5.90	10K	0.070	0.200	0.340	0.003
	11 40	0025	13.5	7.8		80	5.90	10K	0.060	0.300	0.450	0.005
	11 40	0050	8.0	8.8		72	5.70	10K	0.320	0.600	0.240	0.006
73/10/04	15 50	0000	17.9	8.0	82	90	6.40	10K	0.090	0.600	0.160	0.006
	15 50	0020	16.9	7.4		92	6.20	10	0.070	0.500	0.150	0.006
	15 50	0030	11.4	0.4		74	6.00	13	0.320	0.700	0.270	0.005
	15 50	0040	8.9	0.2		81	6.10	19	0.530	0.900	0.050	0.003
	15 50	0055	7.9	0.4		96	6.80	14	0.860	1.300	0.040	0.007

22

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/23	11 35	0000	0.005	0.8
	11 35	0004	0.005	
	11 35	0015	0.005	
	11 35	0029	0.005	
	11 [illegible]	0040	0.004	
73/07/25	11 [illegible]	0000	0.013	7.8
	11 [illegible]	0005	0.010	
	11 [illegible]	0015	0.012	
	11 [illegible]	0025	0.008	
	11 40	0050	0.008	
73/10/04	15 50	0000	0.009	6.9
	15 50	0020	0.007	
	15 50	0030	0.006	
	15 50	0040	0.008	
	15 50	0055	0.069	

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 75/01/21

422302
40 02 45.0 078 52 22.0
INDIAN LAKE
42111 PENNSYLVANIA

FEMALES
3

2111202
0015 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/23	12 35	0000	14.3		144	120	6.90	15	0.050	0.200K	0.540	0.004
	12 35	0004	14.5	9.8		120	6.80	10K	0.080	0.200K	0.530	0.003
	12 35	0018	8.3	10.2		120	6.70	10K	0.090	0.200K	0.500	0.003
73/07/25	12 45	0000	23.5		120	110	7.00	10K	0.050	0.600	0.260	0.006
	12 45	0005	23.4	7.8		109	6.30	10K	0.040	0.500	0.240	0.004
	12 45	0011	23.2	7.8		110	7.10	10K	0.060	0.500	0.250	0.006
73/10/04	16 15	0000	17.7	8.8	84	98	6.80	10K	0.170	0.800	0.160	0.006
	16 15	0014	17.2	7.0		100	6.30	10K	0.170	0.600	0.150	0.006

23

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/23	12 35	0000	0.004	1.1
	12 35	0004	0.004	
	12 35	0018	0.004	
73/07/25	12 45	0000	0.010	4.4
	12 45	0005	0.011	
	12 45	0011	0.011	
73/10/04	16 15	0000	0.014	7.0
	16 15	0014	0.013	

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/01/27

422303
40 02 25.0 078 51 43.0
INDIAN LAKE
42111 PENNSYLVANIA

11EPALES
3

2111202
0033 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/23	13 10	0000	13.2		7<	110	6.80	10<	0.040	0.500	0.490	0.005
	13 10	0004	12.7	10.8		115	6.70	10<	0.040	0.200	0.500	0.004
	13 10	0015	9.2	10.8		110	6.70	10<	0.030	0.200<	0.500	0.004
	13 10	0024	7.0	10.5		110	6.70	10<	0.100	0.300	0.490	0.005
73/07/25	13 05	0000	23.6		84	104	6.10	10<	0.070	0.600	0.340	0.004
	13 05	0005	23.4	7.6		104	6.10	10<	0.050	0.700	0.330	0.005
	13 05	0015	22.8	9.0		102	6.40	10<	0.070	0.700	0.350	0.005
	13 05	0029	11.3	3.4		79	5.86	10<	0.200	0.800	0.320	0.005
73/10/04	15 25	0000	17.4	8.2	1M	90	6.30	10<	0.120	0.800	0.170	0.006
	15 25	0015	17.5	7.5		92	6.20	10	0.040	0.400	0.160	0.006
	15 25	0026	16.2	3.4		89	6.00	14	0.280	0.600	0.150	0.007
	15 25	0029	12.6	1.2		91	6.30	21	0.540	1.000	0.040	0.007

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/23	13 10	0000	0.008	0.6
	13 10	0004	0.006	
	13 10	0015	0.006	
	13 10	0028	0.006	
73/07/25	13 05	0000	0.010	0.6
	13 05	0005	0.009	
	13 05	0015	0.009	
	13 05	0029	0.010	
73/10/04	15 25	0000	0.008	0.2
	15 25	0015	0.007	
	15 25	0026	0.008	
	15 25	0029	0.010	

K VALUE KNOWN TO BE
LESS THAN INDICATED

42

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 75/02/03

4223A1
40 00 57.0 078 54 00.0
RHOADS CREEK
42079 SOMERSET CO HWY
0/INDIAN LAKE
SEC RD BRDG IN SHANKSVILLE
MEMALES 2111204
0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/14	15 10		0.480	0.225	0.065	0.005K	0.015
73/06/17	10 00		0.440	1.570	0.069	0.005K	0.015
73/07/15	13 00		0.400	0.440	0.078	0.005K	0.020
73/08/11	14 10		0.378	1.980	0.189	0.008	0.015
73/09/09	08 50		0.336	1.200	0.154	0.005K	0.020
73/10/12	14 10		0.410	0.550	0.132	0.014	0.014
73/11/09	13 50		0.420	1.200	0.104	0.016	0.035
73/12/18	13 30		0.368	0.906	0.120	0.008	0.015
74/01/15	13 50		0.588	1.100	0.124	0.005K	0.020
74/02/10	13 15		0.530	0.700	0.140	0.005K	0.005K
74/02/27	14 15		0.650	0.800	0.155	0.010	0.010
74/03/10	13 20		0.552	1.700	0.135	0.005K	0.010
74/03/24	14 00		0.580	2.100	0.120	0.005	0.005
74/04/15	13 45		0.520	0.300	0.080	0.005K	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/03

423881
40 01 28.0 078 52 25.0
UNNAMED CREEK
42 SOMERSET CO HWY
T/INDIAN LAKE
RD 55063 BRDG .25 MI BELO DAM OF N LAKE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/19	16 05		0.450	1.260	0.080	0.005K	0.005K
73/06/17	10 40		0.340	2.400	0.084	0.005K	0.015
73/07/15	13 45		0.190	0.270	0.030	0.005K	0.010
73/08/11	14 45		0.120	0.360	0.040	0.005K	0.010
73/09/09	09 40		0.176	0.750	0.062	0.005K	0.010
73/10/12	14 35		0.154	0.700	0.067	0.007	0.007
73/11/09	14 15		0.160	1.300	0.116	0.005K	0.006
73/12/18	14 05		0.232	0.800	0.100	0.005K	0.010
74/01/15	14 30		0.420	0.400	0.095	0.005K	0.010
74/02/10	13 45		0.368	0.600	0.125	0.005K	0.005K
74/02/27	15 00		0.470	1.400	0.120	0.010	0.025
74/03/10	12 45		0.410	1.100	0.135	0.005K	0.025
74/03/24	14 45		0.460	0.700	0.105	0.005	0.005K
74/04/15	14 30		0.410	0.400	0.077	0.005K	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/03

422361
40 02 50.0 078 50 00.0
CLEAR RUN
42 SOMERSET CO HWY
T/INDIAN LAKE
UNORY RD BRDG 1 MI S OF REELS CORNER
11EPALES 211120+
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/14	15 48		0.231	3.150	0.138	0.005K	0.005K
73/06/17	10 25		0.160	0.380	0.025	0.005K	0.010
73/07/15	15 30		0.280	2.730	0.094	0.005K	0.010
73/08/11	14 30		0.200	1.380	0.063	0.005K	0.020
73/09/09	09 10		0.053	0.740	0.036	0.005K	0.040
73/10/12	14 25		0.050	0.250	0.037	0.006	0.005
73/11/09	14 10		0.252	1.050	0.038	0.005K	0.025
73/12/14	13 55		0.400	0.400	0.036	0.005K	0.005
74/01/15	14 15		0.588	1.500	0.068	0.008	0.008
74/02/10	14 30		0.350	0.400	0.045	0.005K	0.005K
74/02/27	14 45		0.490	0.600	0.050	0.010	0.020
74/03/10	13 40		0.430	2.700	0.125	0.005	0.010
74/03/24	14 30		0.420	0.300	0.040	0.005K	0.005K
74/04/15	14 15		0.430	0.500	0.035	0.005K	0.005K

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/03

422301
40 00 35.0 078 51 25.0
BOONE RUN
42 SOMERSET CO HWY
1/INDIAN LAKE
GNDRY RD BRDG #T-535 .25 MI E OF BOONE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/14	15 30		1.820	2.600	0.880	0.005K	0.015
73/06/17	10 15		0.399	1.500	0.147	0.005K	0.020
73/07/15	13 15		0.240	2.000	0.170	0.005K	0.015
73/08/11	14 20		0.410	0.860	0.220	0.007	0.012
73/09/09	09 00		0.810	1.020	0.730	0.005K	0.010
73/10/12	14 20		0.110	0.600	0.115	0.005K	0.010
73/11/09	14 00		0.290	0.650	0.096	0.005K	0.050
73/12/18	13 40		0.267	0.600	0.066	0.005K	0.010
74/01/15	14 00		0.860	1.900	0.510	0.012	0.060
74/02/10	14 35		0.208	0.200	0.050	0.005K	0.005
74/02/27	14 25		0.490	0.400	0.150	0.010	0.035
74/03/10	13 30		0.490	2.000	0.150	0.005K	0.015
74/03/24	14 15		0.880	1.300	0.300	0.005K	0.015
74/04/15	14 00		0.368	0.600	0.110	0.005K	0.015

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/10

422321
40 03 00.0 078 52 27.0
INDIAN LAKE LODGE
42 SOMMERSET COUNTY
0/INDIAN LAKE
INDIAN LAKE
11EPALES 2141204
0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO3&NO2 +-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
74/03/18	11 00		25.200	2.000	0.130	3.600	4.500	0.003	
74/04/24	10 45		27.600	3.400	0.150	2.600	3.300	0.003	
74/05/30	09 30		34.000	5.400	0.200	5.400	7.000	0.005	
74/06/30	00 00								
CP(I)-			19.300	3.300	0.140	4.000	5.300	0.008	
74/06/30	24 00								
74/08/08	00 00								
CP(I)-			3.300	1.200	0.050K	0.900	1.100		0.004
74/08/08	24 00								
74/04/04	11 00		18.400	2.500	0.260	3.750	4.100	0.005	0.005
74/04/29	22 00		10.000	2.000	0.260	2.200	2.400	0.004	0.005

K VALUE KNOWN TO BE
LESS THAN INDICATED

30